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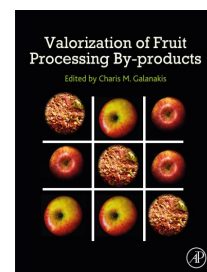
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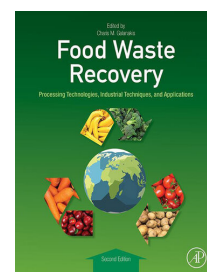
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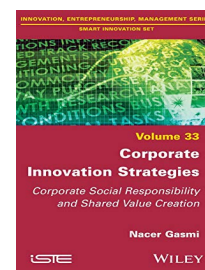
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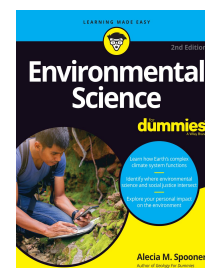
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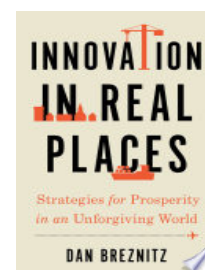
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Innovation Strategies in **Environmental Science**



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Preface

Environmental science and technology (wastewater management, renewable energy technologies, waste disposal, etc.) help in improving the natural environments that give healthy life to human beings by providing pure water, air, and land and also keeping the area pollution-free. In addition, consumers and companies nowadays are looking for alternatives to mitigate pressing environmental demands resulting from continuous population and economic growth. Nevertheless, it is not a secret that the environmental sector is lately facing technical and economic changes in spite of society, processing, and legislation. This fact has significantly affected the entire sector, forcing public authorities and involved companies to pay greater attention to developing processes, services, and products that meet people's demands for a cleaner environment, cleaner production, and a more sustainable world. At the same time, companies must deal with an increasingly competitive scenario in which innovation is a survival requirement in most markets.

As a consequence, there is an extensive dialogue about the need to introduce economically viable innovations in order to optimize performance and make for even more environmental sustainability. Innovations in the environmental sector target the generation of more effective processes, technologies, services, solutions, and products that are readily available to markets, public authorities, and society. However, even though researchers and companies develop continuously innovative products, services and treatment technologies, their applications encounter several obstacles. The last is concerned more with the introduction of innovations due to legislation, public opinion, and other issues and less with the technological adequacy of the innovative techniques. For instance, ecodesign is known to contribute to environmental sustainability via the development of eco-friendly products; however, many studies have pointed out difficulties in adopting ecodesign for practitioners and scholars.

On the other hand, most books report the characteristics of innovative technologies, products, etc., but lack information about how these innovations could be implemented in the environmental sector—e.g., overcoming limitations, interactions between academia and industry, transfer of know-how, and meeting public expectations and environmental concerns. There is also a lack of interpretation between the information received by researchers and technology end users.

The Food Waste Recovery Group (www.foodwasterecovery.group of the ISEKI Food Association) is organizing different training and development actions in the field of food and environmental science and technology—e.g., a basic theory (“The Universal Recovery Strategy”), a reference module, an e-course, training workshops, webinars, an experts’ database, and news channels (social media pages, videos, and blogs) for the timely dissemination of knowledge and an open innovation network aimed at bridging the gap between academia and the food industry. In addition, the group has published books dealing with food waste recovery technologies, different food processing by-products’ valorizations (from olives, grapes, cereals, coffee, meat, etc.), sustainable food systems, and innovations in the food industry, among others. Following these efforts, the current book aims to address the ongoing innovations in the environmental sector by providing tools, ideas, and strategies to overcome bottlenecks to their practical implementation. The ultimate goal is to bridge the gap between researchers, strategy developers, and technical associates (scientists and engineers).

The book consists of 9 chapters. Nowadays, the challenges related to the transformation of the waste management system into a “green” system cannot be addressed only by considering incremental (technological) improvements in recovering waste because addressing these challenges requires an overall paradigm shift. Starting from these premises, Chapter 1 discusses the pressures pushing current waste management systems to become greener, emphasizing the Ukrainian case study. The analysis is framed within the theory of sociotechnical transitions and a multilevel perspective, investigating the role played by landscape actors in exerting “narrative pressure” upon the ongoing waste sector.

The growing awareness of environmental sustainability has fully reached business reality; meanwhile, systematic academic research is paramount to guiding companies to succeed in product innovation toward this approach. Chapter 2 consolidates extant research and aggregate findings of different studies on environmentally sustainable product innovation through an interpretative framework of published literature on the topic and maps critical success factors that drive product innovation developed with this new logic of production and consumption.

In Chapter 3, similarities, differences, and potential connections between two complementary approaches are presented, aimed at understanding opinions regarding the controversial topic of power sources. The first method is the emerging and increasingly popular technology of “text mining,” which uses text as inputs from people and analyzes the structure of such texts. Freely emitted text allows understanding of the underlying mind-sets of the people generating the text. The second method, “mind genomics,” comprises designed experiments, using people’s systematically varied texts to understand the “algebra of the mind.” The referred empirical study involved the mind genomics assessment of solar and nuclear energy, respectively.

Chapter 4 discusses the intersections among environmental sustainability engagement of companies, process innovation and sustainable business models. Many theoretical

frameworks (including stakeholder, legitimacy, institutional, and signaling theories) offer economic and institutional rationales that elucidate why environmental sustainability has become a priority for companies. Since the discussion on environmental sustainability of companies has shifted on the mechanisms that allow an implementation in their business models, this chapter discusses the role of innovation toward sustainable business models, also from a business case perspective, and reviews a set of frameworks capable of orienting the implementations of sustainability within the operations of a company.

In Chapter 5, the study of new knowledge opportunities through open innovation to achieve environmental improvements in traditional industries is discussed. By studying the properties of such cooperation networks, the results in two industries are presented using data from PITEC (2011) for a manufacturing agrifood industry and a tourism service industry. Both industries have considerable economic weight in countries like Spain, but each has a different strategic behavior toward eco-innovation, including industries that produce similar products or services. In addition, the chapter highlights the importance of studying the depth and breadth of relationships with external sources for environmental purposes, reaching different conclusions depending on the analyzed industry.

Ecodesign is today recognized as a practice to reduce environmental impacts in the early phases of new product development as well as during the product life cycle. Therefore, Chapter 6 discusses ecodesign practices and tools from three new product development perspectives. The first emphasizes the importance of integrating ecodesign in the process of new product development and product portfolio decision-making. The second perspective deals with methods and tools that foster practical applications of ecodesign like environmental quality function deployment, materials, energy, and toxicity matrix. Thereafter, the predominant issues that motivate ecodesign are discussed in addition to some barriers to adopting it. Finally, the chapter describes some examples of ecodesign research and applications in Brazilian companies.

Chapter 7 aims to help researchers and practitioners understand what issues or subjects have been addressed in green and low-carbon technology innovation and initiate a journey for the next generation of sustainable-oriented research. The research of Western Europe and North America is highly advanced compared with that of developing countries, especially in terms of new resource and renewable energy technology innovation. Likewise, empirical research is prevalent over other methods—e.g., sample surveys and field studies with primary data compared with conceptual, qualitative, and formal model research. So far, the research fields have mainly focused on technology adoption, diffusion, transfer, policy making or implementation, and advanced technology development. New vibrancy of advanced theoretical and methodological research is particularly needed, especially for low-carbon technology innovation trajectory, performance evaluation, government policy instruments, and multilevel cooperation among enterprises, governments, and nongovernmental organizations.

Sustainability is also a major concern in the water sector. Indeed, compliance with current legislation alone does not seem to be enough for facing major challenges such as climate change or population growth and concentration; thereby, companies should decide to take a step forward. Chapter 8 focuses on the environmental responsibility of small- and medium-sized enterprises in the water and waste management sector, analyzing the drivers that lead these firms to adoption of more sustainable and innovative practices. Market pull has a low incidence in encouraging environmental responsibility, while values and the strategic decisions of entrepreneurs seem decisive. Policy makers should prioritize subsidies over fiscal incentives because they show greater potential to promote the adoption of environmental responsibility among these firms.

Chapter 9 discusses the application of membrane technologies for wastewater treatment and desalination, highlighting advantages, disadvantages, bottlenecks, and innovation barriers upon the actual and sustainable implementation of these technologies in the field. The chapter focuses on the development of membrane processes for several niche areas including heavy metal and color removal, oily wastewater treatment, desalination, and energy generation. At the moment, many fabrication methods have been established and successfully implemented for membrane modification in order to improve membrane separation performance, and long-term stability. The selection of an appropriate method strongly relies on the compatibility of membrane materials with additives, durability of membrane materials toward modifications that might involve harsh conditions, cost-effectiveness, purpose of separation, and types of operations as well as practicability for large-scale operations so that they are commercially attractive.

Conclusively, the book addresses environmental technologists, professionals, specialists, and students working or studying in the environmental sector. It concerns researchers working in the whole environmental science and technology field as well as scientists in transition from active research to administration, in both the academy and industry. It could be used by university libraries as a textbook and as ancillary reading in graduate- and postgraduate-level courses in environmental science, technology, and innovation fields as well as environmental management programs and business schools. The book can also be a useful guide for research and development companies who intend to investigate and utilize technologies to reduce and control environmental pollution.

I would like to acknowledge all the authors for the acceptance of my invitation and their fruitful collaboration in this book project. Their dedication to editorial guidelines and timelines is highly appreciated. In addition, I consider myself fortunate to have had the opportunity to work together with international experts from Albania, Brazil, China, Hungary, Italy, Malaysia, Sweden, Spain, the UK, Ukraine, and the USA. I would also like to thank acquisition editor Janco Candice, book manager Katerina Zaliva, and Elsevier's production team for their help during editing and production.

Last but not least, I have a message for every individual reader of this book. This book contains scientific feedback described by more than 100,000 words. It is therefore impossible for it to not contain any errors or gaps. If you find anything amiss or have any suggestion or comment, please do not hesitate to contact me for further discussion.

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From waste to value: assessing the pressures toward a sustainability transition of the Ukrainian waste management system

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1. Introduction

Waste represents one of the most important environmental problems worldwide. Calculation of the quantity of waste globally produced remains problematic, but its amount continues to rise mainly owing to the increasing world population, urbanization, and the change in consumption patterns (Xue et al., 2008). According to World Bank estimations, the amount of solid waste generated in the world's cities in 2016 reached 2.01 billion tons and is expected to increase by 70% to 3.40 billion tons in 2050 (Kaza et al., 2018). Indeed, the quantity and content of waste generated in a country are related to some

extent to the size of the population and may differ significantly across regions or cities; developing economies exhibit a larger proportion of waste compared with developed ones ([World Bank, 2012](#); [Hoornweg and Bhada-Tata, 2012](#)). Data suggest that daily per capita waste generation in high-income and low/middle-income countries is expected to increase, respectively, by 19% and 40% by 2050 ([Kaza et al., 2018](#)).

According to Directive 2008/98/European Community (EC), waste is “any substance or object which the holder discards or intends or is required to discard.” A large part of it is represented by municipal solid waste, whereas wastewater is generally classified within the water or industry sectors and waste from mining and quarrying and from construction and demolition as major mineral wastes. Municipal solid waste is composed of electronic waste (e-waste) (e.g., discarded computers, mobile phones, home electrical equipment such TVs, fridges, etc.), construction and demolition waste, health care waste, agricultural residues, and waste produced by households, offices, shops, schools, and industries. The last one includes food waste, garden and park waste, paper, wood, textiles, rubber, plastics, metal, and glass ([UNEP, 2013](#)). The incorrect disposal of waste can cause direct and indirect problems for the environment and human health through many pathways and mechanisms ([UNEP and UNU, 2009](#)). For instance, methane produced in landfills by microorganisms from biodegradable waste (e.g., food, paper, and garden waste) is one of the most powerful gases contributing to air pollution through ozone layer depletion. Moreover, if liquid leachate escapes from landfills into the surrounding soil, a relevant threat to local surface and groundwater systems is posed owing to the high levels of chemical compounds, pesticides, and solvents released. Similarly, heavy metals, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and brominated flame retardants contained in e-waste have potentially dangerous outcomes if improperly disposed of. Along with environmental consequences, poor waste management can have a negative impact on human health, mainly in terms of birth defects and reproductive disorders. Indeed, people living in the proximity of a landfill are exposed to a number of health risks resulting from exposure to pollutants through the inhalation of substances emitted by the site, contact with polluted soil, and the consumption of contaminated water ([World Health Organization, 2016](#)). The appropriate management of waste (in which generation, storage, collection, transport, processing, and waste disposal are accomplished in a way that best addresses the range of public health, economic, engineering, and other environmental considerations) - is therefore recognized as essential for achieving the goal of sustainable development ([UNHSP, 2010](#); [UNEP, 2011a](#)).

From a historical point of view, the waste management system (WMS) essentially dealt with removing potentially harmful materials from urbanized areas ([Papargyropoulou et al., 2014](#); [Wilson et al., 2012](#)). However, this approach, which is based on collecting waste and transporting it disposal sites, seems to be outdated ([Jouhara et al., 2017](#)). Indeed, the increasing emergence of environmental and human

health problems associated with waste has raised the need for a greener WMS whose primary goals should be to reduce the adverse impacts of waste and support economic development and a superior quality of life (Bringezu and Bleischwitz, 2009).

According to this perspective, the WMS needs to be transformed into a more holistic approach whose related challenges should be addressed through an overall paradigm shift, i.e., a radical change involving the infrastructural, institutional, and social dimensions (Markard et al., 2012). In other words, following a circular economy approach, the greening of the WMS should be accompanied by a sociotechnical transition toward a new and more sustainable regime (Geels, 2018). Indeed, along with incremental technological improvements in recovering and disposing of waste, waste management problems encompass a number of elements such as markets, user practices, cultural meanings, infrastructures, policies, industry structures, and supply and distribution chains, which can be unitarily considered through the multidimensional and coevolutionary perspective of sociotechnical transitions (Zarate et al., 2008). A core issue in this approach is the relation between *stability* and *change*. Green innovations and practices in the field of waste management struggle against the current locked-in system that creates stable and path-dependent trajectories (Walker, 2000). The transition approach involves a long-term horizon that considers the time needed for changes in technologies, from their early emergence in small-application niches to widespread diffusion as well as the time necessary to destabilize and unlock the dominant system and overcome resistance from incumbent actors (Rotmans et al., 2001).

Starting from these premises, the current chapter investigates the case of the Ukrainian WMS by identifying actors that exert pressure on the system to become greener, as well as the channels through which such actors apply pressure. In other words, we analyze the pressures the current (unsustainable) regime is receiving regarding a system approach for reducing, recycling, and reusing waste, encouraging the recycling of raw materials from products, moving toward near-zero waste, and preparing and promoting innovation procurement for resource efficiency.

The Ukrainian case study is particularly relevant because of the magnitude of the problem (i.e., the amount of waste generated at the country level, compared with other developed economies) and the general lack of adequate infrastructures for efficient waste management. The high level of waste produced and the low rate of its use as secondary raw materials led to the significant accumulation of waste from the industrial and municipal sectors, which ended up in landfills. The Ukrainian Cabinet of Ministers approved the 2030 National Waste Management Strategy on November 8, 2017. Its priority is the conversion of waste into energy through extensive technological modernization. The strategy envisages introducing circular economy principles by encouraging waste prevention and recycling.

2. Theoretical framework

2.1 The hierarchy of waste

As discussed in [Section 1](#), the relevance of environmental and health implications arising from improper waste disposal makes the green transformation of the WMS an escalating concern. A tool commonly employed to describe the order of preferred actions for reducing and managing waste according to the assumed environmental impacts is represented by the waste hierarchy, which assesses processes that protect the environment and human health from least to most favorable ([Hultman and Corvellec, 2012](#)). The waste hierarchy can be traced back to the 1970s, when the environmental movement started to critique the practice of disposal-based WMS. The movement supported the idea that waste is a whole of different materials that should be treated differently rather than a homogeneous mass to be buried ([Schall, 1992](#)). In particular, some materials should not be produced at all, others ought to be reused, recycled, or composted, others burned, and others buried ([Gertsakis and Lewis, 2003](#)). The diffusion of the waste hierarchy significantly influenced waste management in many countries, even when the green transformation of WMS had already begun ([Parto et al., 2007](#); [Dijkgraaf and Vollebergh, 2004](#)). It was introduced for the first time in the European Union (EU) policy in 1975 through the Waste Framework Directive (1975/442/EEC). Later, the Community Strategy for Waste Management ([EC, 1989](#)) argued that prevention represents the first guideline in waste management and that waste that cannot be prevented should be recycled or reused, and that only when these last two options are not feasible should it be disposed. In 2008, Directive 2008/98/EC introduced a new five-step hierarchy to the EU's waste legislation which member states must introduce into national waste management laws. Although the Directive 2008/98/EC advises member states to consider both social and economic impacts along with environmental ones, the waste hierarchy focuses primarily on environmental over economic factors ([Papargyropoulou et al., 2014](#)).

Overall, the hierarchy is founded on the principles of minimizing the depletion of natural resources, preventing waste, and using lifecycle thinking, by establishing preferred program priorities based on sustainability ([UNEP, 2011b](#)). The priority order between alternatives is related to the ability of each option to achieve diversion from the landfill ([Van Ewijk and Stegemann, 2016](#)). Accordingly, the most preferred option is represented by prevention, followed by reuse, recycling, and recovery (including energy recovery) and, as a last option, safe disposal. In this framework, the first priority (prevention) aims to avoid and reduce the generation of waste by encouraging consumers, producers, and government to minimize the amount of materials extracted and used. Prevention can be achieved by following a number of new behaviors such as selecting goods with the least packaging or that require the fewest resources to be produced, avoiding disposable goods or single-use materials, buying recycled, reusable, or biodegradable products, and using

leftover food rather than throwing it away. The second priority (preparing for reuse) aims at providing products with a second life before they become waste through substitution (so that no new material is necessary to fulfill the need) and/or postponing (by extending their life through good maintenance practices, repair, and refurbishment). Reuse does not require further processing, so the third priority within the waste hierarchy (recycling) consists of processing waste materials to produce the same or a new good, thus keeping materials in the productive economy and minimizing the need for new materials and waste absorption. Recycling can involve a number of different materials such as aluminum, copper, steel, rubber tires, polyethylene and polyethylene terephthalate bottles, glass, paperboard cartons, and light paper. However, when waste cannot be prevented and materials cannot be reused or recycled, the fourth priority (recovery) aims to promote technologies for extracting energy from materials instead of mass burning organic waste with no energy recovery. Only from this point on, discarded materials are considered waste. More specifically, energy recovery represents the conversion of nonrecyclable waste materials into usable and renewable energy (heat, electricity, and fuel) through a variety of processes. This contributes to reduce air emissions by reducing methane generated from landfills and offsetting the need for energy produced from traditional fossil sources. One of the most widespread thermal treatments employed to recover energy is represented by incineration, which reduces the volume of disposed waste by up to 90% and produces gas that can be exploited to create steam (Marshall and Farahbakhsh, 2013). Pyrolysis and gasification are two more advanced thermal waste treatments: the first represents the thermochemical decomposition of organic material at a high temperature into gas, oil, and char in the absence or presence of a small amount of oxygen, whereas the second takes place in an atmosphere poor in oxygen, which produces char and synthesis gas (Klinghoffer and Castaldi, 2013). However, both of them still have a number of technical limitations and inefficiencies mainly because some of the energy produced must be necessarily be employed to power the process, which reduces the overall benefits (DEFRA, 2013; Lin et al., 2013; Mohan et al., 2006). In contrast, a particularly viable option for recycling the organic fraction of municipal solid waste is represented by anaerobic digestion, which produces biogas, a mix of methane, carbon dioxide, and other gases in small quantities that can be converted to generate electricity and heat, and as a substitute for natural gas and transportation fuel (Xu et al., 2016). Moreover, the digested slurry can be further processed to obtain compost and liquid fertilizer (Khalid et al., 2011). Along with turning waste into a resource, the contribution of biogas to the greenhouse effect is limited, which is a main reason why anaerobic digestion can have a key role in meeting the energy needs of the future. Finally, when materials are inappropriate for reuse, recycling, or recovery for energy, the fifth and least preferred option in the waste hierarchy is represented by disposal, which requires specific treatments to minimize environmental and health impacts.

A relevant criticism regarding the waste hierarchy is that it organizes priorities according to a consensus ranking that does not take fully into account the possible environmental and human health consequences arising from adopting each option (Rasmussen et al., 2005). For instance, recycling can produce environmental effects during the treatment associated with transportation, energy use, and other residuals that occur in relation to the recycling process. For this reason, we should have different hierarchies according to the type of waste, and even the country analyzed. Moreover, reuse seems not be applicable in municipal solid waste management, in which the opportunities to achieve significant reductions in waste volumes through reuse are limited. Similarly, the possibility of achieving real environmental savings from recycling can be limited or excessively expensive in the case of many multimaterial products, which makes this option not always feasible. Furthermore, the literature (Wilkinson, 2002; Mazzanti and Zoboli, 2008; Finnveden et al., 2013) suggests that implementation of the waste hierarchy has failed so far to achieve the most preferable alternatives to landfills: in particular, prevention seems to be far from being fully attained. This can arise from a conceptual problem regarding the hierarchy of waste and more generally the WMS, which includes prevention although waste managers seem substantially powerless (Van Ewijk and Stegemann, 2016). Indeed, a WMS is conceived of as a set of tasks ranging from waste generation (i.e., the whole of activities involved in identifying materials that are no longer usable) to onsite handling and processing (i.e., activities carried out at the point of waste generation to facilitate collection), waste collection (i.e., activities such as placing waste collection bins and collecting waste from those bins), waste transfer and transport (i.e., activities involved in moving waste from local waste collection sites to regional ones), waste processing and recovery (i.e., activities aimed at recovering reusable and recyclable materials from the waste stream), and disposal (i.e., activities for the disposal of waste materials in landfills and waste-to-energy facilities). Within this framework, although prevention is traditionally associated with the first task executed from the WMS (i.e., waste generation), it should be more correctly related to consumers and companies' behavior, because once materials are discarded and collected, there is no further opportunity for prevention. When goods are disposed of, the possibility their being reused becomes much more complicated than the reuse of goods that have not been discarded, because they cannot easily be removed from controls on waste management. From this viewpoint, a radical change in the way people approach environmental and health problems arising from incorrect waste disposal is necessary because even weight- or volume-based collection fees that act as a deterrent to disposal do not discriminate between goods that must be disposed of and those that can be reused or recycled.

Despite such shortcomings, the hierarchy of waste represents a relevant and environmentally desirable approach to achieving the greening of the WMS based on the

importance of waste diversion from the landfill to safeguard the environment and human health. However, its practical application requires a deep change in the waste management technologies employed as well as the behaviors of all actors involved in the process. In other words, it must be sustained by a sociotechnical transition able to encompass the radical changes necessary at the infrastructural, institutional, political, and social levels to achieve the goal of a green waste sector. For this reason, in the current work, we investigate the greening of the WMS in the framework of sustainable transitions, i.e., sociotechnical transitions toward a more sustainable regime.

2.2 Waste sector and sociotechnical transitions

Environmental and health human problems arising from the incorrect disposal of waste involve a large scale and complex level; consequently, they must be addressed through more substantial shifts than by means of incremental green technologies (Elzen et al., 2004). Within this perspective, the approach of sociotechnical transitions considers the multiple actors and disruptive, long-term, and nonlinear processes surrounding the shift toward a green WMS, other than to capture uncertainty stemming from the nonlinear character of political, sociocultural, and innovation processes related to waste management. These transitions are labeled sociotechnical because they “not only entail new technologies, but also changes in markets, user practices, policy and cultural meanings” (Geels, 2010: 495). One of the main orienting frameworks employed in the literature to investigate sociotechnical transitions is represented by the multilevel perspective (MLP), which describes transitions in terms of alignment within and among three analytical levels: niche innovations, sociotechnical regimes, and the sociotechnical landscape (for a graphical representation of the basic model, see Geels, 2011, p. 28). According to this viewpoint, the MLP represents an innovative analytical framework that is more comprehensive than a microfocus on single economic agents and at the same time more concrete than a macrofocus on the green economy (Geels, 2018).

The sociotechnical regime represents the mesolevel unit of analysis. It can be defined as a stable configuration of institutions, techniques and artifacts, rules, and practices that determine the normal development and use of technologies. In other words, the regime represents the existing way of doing things, such as designing and manufacturing products, framing expectations, and assigning values (Pesch, 2014). The different social groups (engineers, scientists, policy makers, and users) involved in the regime embed a semicoherent set of rules and cognitive routines supportive of the existing system, opposing resistance to any possible transition toward a new sociotechnical system (Falld and Eklund, 2015). Normally, a regime accepts normally incremental innovations in the short term and radical innovations only in the long term.

The niche innovations level represents the microlevel and consists of protective application spaces or incubator rooms (niches) for technologies that deviate from existing regimes. Niches aim to enhance the further development and rate of application of new technologies, enabling learning regarding expectations, networks, and technical features. Although niche innovations may perform poorly in more conventional terms (for example, in terms of price), they are given the opportunity to be evaluated and to mature through gradual experimentation and learning by niche actors (producers, users, researchers, and so on) (Steinhilber et al., 2013).

Finally, the sociotechnical landscape represents the macrolevel. It can be considered an external structure or context for interactions of actors in which a number of different and heterogeneous forces exert pressure upon the mesolevel and microlevel (i.e., the regime and the niche). The landscape includes factors that do not change or that change only slowly (e.g., the climate, cultural values, demographic trends, broad political changes) as well as rapid exogenous shocks (e.g., wars, economic crises, shocks in oil prices) (Söderholm and Wihlborg, 2015).

The relation among these three levels can be explained as follows. The sociotechnical regime accounts for the dynamic stability of existing technological developments, because it guides innovative activity by means of incremental innovations along trajectories. The sociotechnical landscape consists of changing external factors that provide deep structural gradients of force, making some trajectories easier than others. Finally, the niche innovations level accounts for the development of radical innovations (Geels and Schot, 2007). The three levels are more than ontological descriptions of the reality: they represent “analytical and heuristic concepts to understand the complex dynamics of sociotechnical change” (Geels, 2002, p. 1259).

A transition represents the emergence of a new sociotechnical system that, in the long term, will replace the existing system. It is the consequence of coevolutionary dynamics that are not limited to a shift in the technologies being used, but that involve changes in production techniques, distribution networks, regulations, symbolic meaning, etc. In particular, it occurs when pressures from the landscape level couple with sufficiently developed niches (Upham et al., 2014). According to the model, niche innovations struggle against the existing regime, needing to propagate sufficiently to transform existing arrangements. The selection and integration of niche-level innovations by regimes is more than adoption, because regime-level actors have to integrate new technologies in their practices, organizations, and routines. When the sociotechnical landscape exerts destabilizing pressures on the existing regime, niche innovations have the opportunity to emerge and compete with the existing regime and eventually go into the mainstream markets (Turnheim and Geels, 2012). These conditions do not cause, or unidirectionally drive, the others,

but they link up with and reinforce each other, following a process of circular causality. Moreover, interactions among niche, regime, and landscape occur following several phases: for example, emergence, takeoff, acceleration, and stabilization (Binder et al., 2017).

Within this framework, *sustainability* transitions can be conceived of as transitions toward a more sustainable regime in which the sociotechnical system encompasses the creation, adoption, and diffusion of sustainable technologies supported by changes at the social, institutional, and policy levels (Loorbach et al., 2017). Compared with other sociotechnical transitions, they are purposive and not “emergent” because they address persistent environmental issues (Geels, 2011). Moreover, they must deal with free rider problems owing to the public good nature of the goal addressed (i.e., environmental sustainability) (Smith et al., 2005). When a sustainability transition concerns the WMS, it involves a deep change in consumers’ attitude toward waste prevention and reuse of materials, accompanied by improvements in recycling techniques as well as in technologies normally employed to recover energy from waste (Kemp and van Lente, 2011). After a transition occurs, the amount of natural resources consumed is significantly reduced, materials taken from nature are reused as many times as possible, and waste generated is generally kept to a minimum. Therefore, the transition toward a green WMS should be inspired by the principles of the waste hierarchy, as discussed in the previous section.

As argued in Section 1, in this chapter we concentrate exclusively on the pressures that the current WMS receives at the landscape level, aimed at making it greener consistently with the circular economy principles mentioned earlier. To this end, we follow Morone et al. (2016) and Falcone et al. (2018) by distinguishing *unintentional* from *intentional* pressures. The first represents exogenous and unpredictable shocks (e.g., earthquakes, wars) occurring at the landscape level that provide a destabilizing pressure on the current sociotechnical regime. In contrast, the second is activities that are deliberately exerted by actors to induce a misalignment of landscape factors from the regime. In this work, we focus specifically on *intentional* pressures, assuming that they can be exerted from two broad categories of actors: (i) *global* and (ii) *national* actors. More specifically, global actors are institutions or organizations that can influence a sustainability shift in a country by operating at the supranational or international level, whereas national actors are institutions or organizations act mainly at the country level, such as national policy makers, grassroots associations, and stakeholders. Moreover, we assume that both global and national actors exert pressure by adopting either an (i) *informal* or (ii) *institutional* route. The first works by means of informal tools of influence, and the second through designed political actions. In this light, we are therefore able to identify *which* landscape actors exert pressure on the greening of the WMS (i.e., “the source of pressure”) and *the way* in which such pressure is exerted (i.e., “the type of pressure”).

Consequently, we identify four possible pressures originating from the landscape level that arise from the combination of the source and type of pressure:

1. global/informal pressure (GLOB/INF)
2. global/institutional pressure (GLOB/INST)
3. national/informal pressure (NAT/INF)
4. national/institutional pressure (NAT/INST)

To destabilize an existing sociotechnical regime, pressure originating from the landscape must be balanced. In other words, an unbalanced pressure, i.e., coming only from one or two source(s)/type(s) could be completely ineffective (Centola and Macy, 2007).

Therefore, along with identifying the source and type of pressure, we will assess the extent to which it is balanced overall across the four categories.

3. The Ukrainian waste management system

3.1 Background

The Ukrainian WMS represents a relevant case study because the country lags well behind in terms of waste prevention, reuse, and recovery. Indeed, despite a territory of 603,628 km² and a population of 44.03 million people, Ukraine has only 2 incineration plants, 15 waste separation plants, and no waste processing plants, so large amounts of waste are still buried in landfills. As a consequence, the waste sector is characterized by the general accumulation of waste in both the industrial and domestic sectors, the improper treatment and disposal of hazardous waste, the storage of household waste without considering possible hazardous consequences, and the inadequate use of waste as a secondary raw material (DLF, 2018). As reported in Table 1.1, these problems stem

Table 1.1: Main problems affecting the Ukrainian waste management system.

Legal	Economic
<ul style="list-style-type: none"> Imperfect system of responsibility for consumer, producers, and authorities as well as of tender procedures in waste-related services Ineffective state control over waste formation and lack of structured fines system Absence of public—private partnerships in waste sector owing to complex legal framework 	<ul style="list-style-type: none"> Underdeveloped domestic market for recycled materials Limited involvement of foreign investors owing to risk of carrying out innovative processes in the country Absence of motivational controlling mechanism to incentive eco-innovations in companies, which limits landfilling
Social	Technical
<ul style="list-style-type: none"> Poor standards of citizens' ecological culture and environmental consciousness General reluctance in households to sort garbage 	<ul style="list-style-type: none"> Unsolved logistics in separation and treatment processes Saturated, unsafe, and outdated waste infrastructures

Own elaboration based on Brauweiler, H.C., Shkola, V., Markova, O., 2017. *Economic and legal mechanisms of waste management in Ukraine. Marketing and Management of Innovations* 2, 359–368. <https://doi.org/10.21272/mmi.2017.2-33>.

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Exploring the Variety of Random Documents with Different Content

the room was filled with its acrid smoke. He could not open the window, for the sleet and rain were beating against the panes. He stopped for a moment watching the water dribble outside down the glass. Then he turned away impatiently, seeking solace from his book-backs and pictures. But they seemed to look back upon him unsympathetically, as if reproaching him for the bare floor, the untidy dresser, and the cheerless hearth. He rekindled his fire, filled a pipe, and sat down to think.

Kent was not given to introspection. His external interests in life were too engrossing for him to think deeply or continuously about himself. Such a habit of mind he used vehemently to deprecate as morbid, egotistical. But now this strange depression, this vague sense of loss, compelled him to account for it to his reason. He began in a sober, materialistic way to review his general health (there are philosophers amongst us who refer all moods to the liver, not looking upon it, however, like the ancients, as the seat of the affections!), to question some little disappointments he had had with regard to his great work, and to dwell upon the futility of existence—the suggestion of which he should have been logical enough to see was the result and not the cause of his state of mind. But he was not logical. Few men are when the great facts of inner life are in question; for in the course of logic “none of us would see salvation,” as far as this world’s happiness is concerned. Gradually a truth dawned upon him. He missed the ever-ready companionship he had enjoyed for nearly a year. He missed Clytie. He found that for the first time in his life since he was a baby he had been depending for something on a woman. He had never realised until then the strength of that unknown subtle influence, the withdrawal of which left him so weak, so unable to put forth all his powers. At first he thought that it was merely the abrupt interruption of pleasant habits, the sudden jerk out of a well-oiled groove. Telling himself he was satisfied with this solution, he resolutely went back to his writing and began to correct his proof-sheets. But gradually his attention wandered again. These sudden impulses to work against the grain

soon spend themselves out and produce greater lassitude than before.

He tossed down his pencil in disgust and swung round towards the fire. It was Clytie herself, then, that he missed. He missed her in spite of her being a woman, he told himself. And yet the picture rose before his mind of Clytie's dainty room and Clytie sitting there opposite to him, her hand, with falling lace at wrist, pressed into the softness of her hair. Why had she not written a line to him?

Yes, he missed her. But why should that make his work distasteful? He was puzzled. One thing alone was clear, his loneliness was growing intolerable. He threw on his waterproof, and, leaving his work, trudged through the rain to the "monastery," at South Kensington.

Wither was alone. Fairfax and Greene were dining out. The little man had been too lazy and sybaritic to face the cold and wet outside. He had clad himself in pyjamas and dressing-gown, and was reading a French novel on the couch drawn up in front of the fire. His diminutive figure looked absurdly small and wizened in his loose wrap. He nodded affectionately at Kent, explained briefly the fact of his being alone, and, while Kent was hunting in a familiar corner for the pair of slippers always there in readiness for his use, went on with his reading.

"Get me some whiskey, old chap," he said without looking up. "I have been dying for some this last hour and I have been too lazy to stir off the sofa."

Kent, as usual, supplied Wither's wants and poured out a glass for himself.

"Lazy little beggar," he said kindly as he sat down in the great saddle-bag chair. "How do you manage to get through your work?"

Wither laughed.

"I thought you knew better than to ask me that."

It was a tradition in the "monastery" that Wither never did any work. They paid him at his office for lending it a gentlemanly tone. As a matter of fact, like most clever, lazy men, he generally did an ordinary man's day's work in a few hours.

He stretched himself out luxuriously and lit a cigarette.

"Have you ever read this?" he asked, holding up his novel. It was Bourget's "Cruelle Enigme."

Kent nodded.

"I skimmed it through here one night while waiting for you. I have no patience with that sort of thing."

"Possibly not," remarked Wither, "but that's a fact about yourself, and not about the book."

"I don't believe it is human life," replied Kent. "People can't make animal passion the keynote of their lives nowadays."

"Why not nowadays?"

"The conditions of life prevent it. The savage has furious brute instincts, which he gratifies occasionally, when his mind is not taken up with fighting and hunting for his food. It may be the guiding principle in a splendid barbarism like some Eastern courts, where men have little else to think of. But in our modern civilisation there are other interests too absorbing. The hurry of life is too great."

"What about the empty-minded women you are always railing at?"

"They are all absorbed in their futilities—at least most of them," he added, correcting himself; "but even when idle they are not beasts. Now this woman you are reading about is a beast."

Wither eyed him curiously.

"You are talking nonsense, old chap. If she had been simply that, she would not have been a problem to the psychologist. The enigma was the sudden burst into animalism in the midst of a love that was almost idyllic."

"Bosh!" said Kent. "It was the same old hideous adultery."

"Oh, well! if you go on those lines, I am done," replied Wither, shrugging his shoulders. "I thought we were a little more advanced in our ideas in this establishment."

"You know I don't mean that," said Kent, puffing violently at his pipe. "The legality of the connection has nothing to do with it. It is the eternal coupling of the male and the female that revolts me. Pah! They might as well write a novel on the loves of the pastures."

"If I could write French, I should like to try it," said Wither. "It would be interesting."

"There is too much of that sort of thing written and talked about," said Kent. "It's sickening. It's degradation of humanity."

"Well, it's not uncommon," said Wither, with a sphinxlike smile playing round the corners of his mouth as he gazed upwards at the cigarette smoke.

"Look here, Wither," said Kent; "I have a higher faith in humanity. You profess to be a cynic, a man of the world, and you delight in calling yourself nonmoral. That's all foolishness, I know. You are the kindest hearted little chap in the world. But can you, as a man of intellectual tastes, sympathise with all this animalism?"

Wither threw away his cigarette, and bending forward laid his hand on Kent's knee.

"My dear old boy," he said, with more earnestness than he generally displayed, "I do call myself a man of the world, for I'm in it and I love it, and I have a very decent bowing acquaintance as well with its pals, the Flesh and the Devil. I know something of men, and as for women, it has been my lot to have been petted by a good few—my size lends itself to that sort of thing. In fact, Gulliver with the Brobdingnag maids of honour is not in it with me. I know all about 'em; and I tell you, old chap, that the Beast, sometimes with a big B and sometimes in diamond type, lies in the nature of us all. There is not a living being with pure blood in his or her veins who is not

overmastered at times by the principle of sex. You scoff at Bourget as a writer of morbid and impossible fiction. Look at your daily papers. Don't you see parsons of hitherto blameless lives running off with their cooks, virtuous women ruining their lives and their husbands' for the sake of some Hercules of a scoundrel—just as the patrician ladies in Rome went mad over the charioteers in the circus! Man alive! it is the Beast, the Beast that may slumber in an old maid's bosom until she is sixty and then drive her into the arms of her footman. How otherwise have you accounted for these things?"

"I have not tried," replied Kent simply. "They have not interested me. They are diseases of the brain, for the physiologist to study, like suicide and murder. I don't believe in them in normal everyday life."

There was a long pause, broken only by Wither's request that Kent should put some coals on the fire, and the rattling of the operation. Wither resumed his reading and Kent pulled at his pipe in silence. At last the former looked up and said suddenly:

"Why do you think people marry?"

"That's funny," replied Kent, with a slight start. "I was just wondering myself. I don't know: money, companionship, family, idiocy—God knows what."

"It has always struck me that you would be the first of us to go," said the other in pure, idle maliciousness.

"I?" cried Kent, with a gesture of disgust. "I marry! give up my work, procreate children I couldn't support! Have to kiss and pet and fondle a woman——"

"Well, you need not do that unless you like," replied Wither, laughing in his gnomelike way. "She might expect it, but she would be soon consoled by the blessedness of pure spirituality."

Kent's reply was interrupted by the return of the absentees, Fairfax, the doctor, and Greene.

"I am so glad you fellows have come back," said Kent; "Wither has been drivelling on his favourite topic until I was beginning to loathe

him."

"He's an immoral little wretch," said the doctor, throwing his greatcoat on Wither's curled-up body—"a pocket Mephistopheles. We keep him here as a kind of Familiar. Oh, what rot dining out is!" he added, with a yawn and a stretch as he seated his burly form on the foot of the couch. "I wish I had stayed at home."

"I wish you had," said Kent. "Let us have just one rubber before I go. There is time."

But Kent walked home that night with a new trouble at his heart that kept him awake a great part of the night.

Meanwhile Clytie was not enjoying herself at Durdleham. At first there were eager embraces, trifling tendernesses and solitudes. The dear prodigal had returned, but the fatted calf was killed discreetly, lest it should convey a husk-flavoured reproach. Grace and Janet bubbled over with light Durdleham gossip, seeking to interest, and Clytie earnestly and sympathetically sought to be in touch with her surroundings. It was a real heartfelt effort on both sides towards harmony. But it soon became patent that these efforts were unavailing. Clytie saw the old prejudices barring her at every turn. She recognised with the bitterness of disillusionment that she was the bit of grit in the family machinery, stopping the smoothness of its working. As long as she identified herself with Durdleham interests things went well; but as soon as she, in her turn, ventured to sketch the bright incidents in her town life she felt a check in the current of mutual sympathy. If she was reserved, her sisters complained. They ought to know something of her friends, her occupations. When she was expansive they shrank cold and crablike into their mail of prejudice.

Her intimacy with a strange Bohemian man was a thorn in the side of the family. Mr. Davenant considered it extremely injudicious, and Mrs. Blather whispered to him that she scarcely thought it moral. Janet was too horrified to allude directly to the circumstance. But, in her neat, prim bedchamber, she prayed to the Almighty to lead her

erring sister out of the paths of temptation. She duly informed Clytie of this act of piety, and when Clytie burst into laughter that was nearer to tears than to merriment, left the room in virtuous indignation.

Clytie could not help confessing to herself that she longed for Kent's companionship, with its broader sympathies and inspiring influences, but the view the household took of it pained her with a sense of aching discomfort, and made her feel a strange diffidence in writing to him as she had promised. She at last addressed him a short little note, stiff and constrained, which reached him the morning after his conversation with Wither and did not help to cheer him. Too proud to wait for an opportunity of posting this letter herself, she placed it on the hall slab together with the rest of the outgoing correspondence of the family. Although a hundred letters might have lain there for post without any one of them attracting Mrs. Blather's attention,—she was too pure-minded a gentlewoman for idle curiosity to be one of her failings,—it was too good an opportunity for the imps who seem sometimes to regulate human affairs to let slip, and as a matter of course Mrs. Blather's eye fell upon the address.

"So you are keeping up a violent correspondence with that man," she remarked acidly to Clytie. It is the way of some women to exaggerate.

Clytie bit her lip, cheeking an impulsive answer. What was the use of a retort?

Women of broad, liberal education, with interests beyond the nursery, still-room, and the afternoon-tea table, are known to live together, like men, in comparative harmony. They have learned the lesson the higher, broader life teaches of rising or declining instinctively to another being's plane of thought or feeling. It is hardly a fault of sex that women are petty, spiteful, and intolerant. When the conditions of life are narrow and illiberal any human being, man or woman, runs the risk of being shaped by them. And that is why Mrs. Blather and Janet, good, upright women according

to their lights, subordinated their affection to their principles, and stood away shocked from their sister. Their traditional ideals of femininity had been sinned against. The crime was all but unpardonable. It was always present with them, always assuming fresh, distorted shapes. They were on a different plane from Clytie, and viewed all her actions in a false perspective.

Clytie was hurt, wounded in her womanly pride. She knew that there was much clay in her composition, and often felt with chastening self-abasement how much nearer the angels Winifred was than herself. Yet she was accustomed to live in an atmosphere free from reproach. Winifred, Kent, the Farquharsons, and others of her friends might touch with light, tender finger on here and there an imperfection in her character or conduct; for this she was grateful, knowing the deeper feelings of esteem and respect that prompted. But to move in a circle where she was looked upon as a black sheep, as a girl on the path to unutterable abysses, galled her to the quick, sent the hot blood mounting in stinging waves to her cheek, leaving the heart cold. Yet she had learned not to blame her sisters over much. She had lost her militant scorn of Jacob. Kent had taught her that although Esau might possess the higher birthright which no bartering of pottage could alienate, there was still saving grace in the stolen birthright which Jacob guarded so jealously. But this knowledge did not make her heart less sore.

The happiest time in this Christmas visit was when she could get away into the old lumber-attic in which she had dreamed so many girlish dreams. It had long been dismantled of the Liberty curtains, Persian rugs, and cheap Japaneseries that had lent it the suggestion of artistic atmosphere the girl of eighteen had craved. It was bare now, except for a table and chair and a few odds and ends of artist's materials, but a fire could be laid in the grate to make things look cheery, and there was still the deeply recessed attic-window where she could stand and look out over the same drear landscape. It was only the ordinary midland succession of fields, now black with winter, and pastures through which the river ran, its course only indicated by the fringing line of pollards and willows. Away on the slope to the

west rose a clump of trees from which peeped a few houses and a church spire, the little village of Wexwith. In the foreground ran the highroad skirted with new red-brick cottages, a touch of sordidness added by man to the ungenerous dreariness of nature. Once this had affected Clytie with a sense of the unutterable melancholy of things. The young are prone to be so affected. They are rather proud when they realise it; it is a kind of youthful vanity. But Clytie, like the wiser among us, sought brightness as she grew older, and although she could not consider the landscape cheerful, looked at it only through the memories of five years. Every spot had associations for her. There was the cottage where she had seen the little bully strike his playmate, the original conception of the picture that had helped to cause her welcome banishment from home. Next to it used to live the old beldame who threw out of doors the custards and jellies that Janet with angelic perseverance used to take her. What cruel mockery she used to make of Janet in those days! Now she submissively helped to carry the custards. Behind the swelling uplands over the village the sun set, a red ball in the wintry sky. For how many wild fantastic daubs had not that formed a background!

It was during these reveries that the picture subject she craved commenced to haunt her as it gradually shaped itself into definiteness. Since her singular interview with the French girl at Dinan a lurid gleam streamed from the gates ajar of mysteries that had baffled her. She had read widely and deeply; but books are only the gloss of life, they are not the text. Its secrets must be read in the living world, with much pain and sleeplessness and wearied eyes. The throbbing page had been presented to Clytie for one sharp moment, blazing, the while, in letters of flame. Such knowledge changes lingering girlhood into womanhood without the aid of passion. It changes sex-pride into sex-sorrow—in higher natures, be it understood. And this sex-sorrow runs in channels hollowed out by ever-varying circumstance and temperament. It flows in the patient, all-enduring devotion of the sister labouring among outcasts, in the militant enthusiasm of the social reformer. It quivers in the hearts of teachers like George Eliot and Elizabeth

Barrett Browning. It lives in the souls of some mothers who tremulously watch the shaping of their daughter's destiny. With Clytie it ran confluent with her artistic impulses. It had influenced them vaguely, dimly, hauntingly for months, but now, at last, stirring, proclaiming itself, insistently demanding expression.

The subject was found: Faustina in her innocent maidenhood. The problem: how to manifest the foreshadowings of passion on the young, clear face?

Clytie spent hours in her attic trying to fix the summer lightnings of features that flashed elusively before her mind. She wished she were in London, to go abroad in the highways seeking after a face. It seemed to her that in the great city she would find the one she wanted, in the park, at the theatre, perhaps among the subdued black rows of women—lines of suppressed volcanic workings—in some great shop. But in Durdleham volcanoes were extinct or regulated by formula to erupt with mild propriety. She began to feel the frenzied weariness of helplessness. If only she could talk to someone—to Kent.

One day Mrs. Blather came into the attic. Clytie was dreaming before incoherent charcoal streaks. The fire had burned low and the draught of the opening door made her shiver.

"Why, Clytie, child, you are blue with cold," said her sister, wrapping her gray woollen shawl more tightly round her thin shoulders. "Why do you mope up here?"

"I am not moping, Gracie," replied Clytie; "I am only working—conceiving a picture, that's all."

"Oh, but you oughtn't to do any work. Have you not come down for a holiday? What's the good of burning the candle at both ends? Come down to the drawing-room and talk to the Howatsons; they are inquiring after you."

"But I am in such a mess!" laughed Clytie, showing her blackened finger tips.

"Well, come down and tidy yourself in my room; there is a fire, and you can warm yourself for a few minutes." Clytie followed her sister down the stairs to the latter's bedroom, where a cheerful fire warmed the cold clean chintz of the hangings. Mrs. Blather sat down by the hearth, while Clytie washed her hands and touched her hair.

"Why don't you tell us more of your work, Clytie?" she said propitiatingly. "Here you are being criticised in the newspapers, quite like a famous person, and we at home know nothing of it."

"Why, Gracie, I thought it did not interest you much."

"We would take an interest if you would only let us."

"But, you see, I paint such queer pictures. I don't think they are your style. And then pictures are not portable like books. If I wrote poetry, you could be deluged with presentation copies; but even we ourselves lose all the result of our work when the picture is sold."

"Of course, but you might write and talk more. And with regard to the 'queer' pictures, don't you think, if you made us your confidantes, the pictures might be a little less—'queer'? You see, Clytie, you are young, and it is your nature to run into extremes. If you were just a little bit restrained by older folks, would you not get what you are so fond of talking about—'truth'—in your work?"

Clytie was somewhat puzzled at Mrs. Blather's conciliatory tone. Was this an effort towards a better understanding, or was it a disguised lecture? She finished her hasty toilet and went and stood by the fire near her sister, her foot on the fender.

"Thank you very much, Gracie," she said, "but would you always understand? Perhaps," she added, smiling, after a pause, "you would want to restrain too much—and where would the picture be?"

"Well, why not try? What is the picture to be about that you are working at now?"

The blood rushed to Clytie's cheeks, which, bent down, caught the added glow of the fire—a contrast, with her rich colour, to the clear,

waxen, negative face of her sister. She broke suddenly into a nervous laugh.

"There! Even from the beginning I couldn't discuss it with you, Gracie. It is only a girl's face—I can't tell you anything more about it."

"Well, that's what I complain of," said Mrs. Blather with growing acidity. "You keep your own sisters in ignorance of your life, and confide everything to this Mr. Kent, who is nothing to you."

"How do you know I have told Mr. Kent about this picture?"

"I was not referring to this one, though by your manner I see you have."

"Well, yes, I have," said Clytie, "because—because—he has the artistic temperament—and he can seize an idea—in fact—why are you saying this to me, Gracie?"

"Because you are not going the right way, Clytie; and it is my duty as your elder sister, who has looked after you since you were so high, to make a last effort to bring you within some restraining influences. We don't like your intimacy with Mr. Kent. It is not what we have been taught to think right. I know you look down upon us as narrow-minded at Durdleham. I think it is better for us. We are shut in, perhaps, between high walls, but the high walls keep us safe."

They were silent for a few moments, then Clytie said: "Gracie, don't you think this subject has been enough discussed? It is wasting words and spoiling good intentions. Suppose we go down to the Howatsons."

CHAPTER X.

One day, about this time, Kent was walking home from the Museum. His spirits had by no means lightened since his conversation with Wither, and he strode along moodily, trying to fix his attention on the arrangement of that evening's portion of the great work. He had gone back to it resolutely and doggedly, and was conscious that it was progressing not badly, but at the same time he had a troubling sense that he was treating it less as an aim than as a cure for existence. Fairfax, the doctor, told him he was overdoing himself, that the strain of double work was telling, advised total idleness, and if possible a change of air. Kent gave the prescription a trial, and went down to the Isle of Wight for a week-end, where he tramped himself utterly tired during the day and bored himself exquisitely during the evening. Then he came back rather worse than when he went. No; he was suffering from change, and not from the want of it.

London was in a pitiable condition. It had snowed, then thawed into slush, and now a hard black frost had set in, rendering the roadways like glass. Already during his walk home Kent had seen four horses down. On the first two occasions he had lent a helping hand. After that it began to grow monotonous, and he hurried past the accidents, anxious to get home out of the sullen iron-bound streets. At the corner of Sloane Square and the King's Road he saw a familiar girlish figure coming towards him. It was Winifred, her dark cheeks glowing with the exercise of walking; but he noticed a look of trouble in her eyes.

"I am so glad to have met you, Mr. Kent," she said; "I want to speak to you. Can you walk a little way with me?"

"Of course, as long as you like. What is the matter? You are not yourself."

"No. I have been upset, so upset; you would hardly think it. Come and I will tell you."

They crossed the road and went on down Lower Sloane Street.

"It's about Jack—Jack, the model, you remember. He has been run over! Oh, it's horrible!"

"And you are going to him?" asked Kent, noticing for the first time a little basket hanging over her arm. "Give me that," he added, taking the basket, which she out of habit surrendered to him. "And these are jellies and what not for him?"

"Yes. Will you come with me and see him, see what can be done for him, rather? His mother is so harsh, so stupid."

"How did you come to hear of the accident?"

Winifred's cheek paled a little and she turned her head from him.

"I saw it myself. Oh, I shall never, never forget it! just outside Sloane Square station; I was coming home, yesterday. The ground was just as slippery as it is now. Oh, how can I tell you! It makes me shudder to think of it!"

"Take your time," said Kent good-naturedly.

She was silent for a few steps. Then, nerving herself, she went on with more coherence.

"He was just in front of me when I came out, and as he saw me he ran away, frightened—like a little scared animal; you know his ways. And crossing the road, not looking where he was going, he turned his head round as if to see I was not following him, and then he slipped—oh-h! under the hoofs of a horse—in a hansom. And the driver tried to pull up sharp, and the horse came down too—on top of Jack!"

"Good God!" said Kent.

"A crowd at once collected. I rushed through—I must have screamed a little and cried that I knew him, for the people made way for me. It all seemed like a horrid dream. I can't tell what

happened, except that I found myself kneeling on the ground with the poor little mite's head on my lap. Then someone was talking to me, who said he was a doctor, and began to examine the boy's injuries."

"Is he badly hurt?"

"The doctor does not know yet. No bones are broken—the injuries are internal."

"Is he at the hospital?"

"No. At his own home. I gave them the address, and told them his mother would care for him—why, I don't know. And then they got a stretcher from the police-station and carried him home, and I went with them and broke it to his mother. But, oh! Mr. Kent, almost the most awful part of it is that it seems as if I was the cause of it."

"Nonsense, my dear child," said Kent in rough earnestness.

"Oh, yes, it is. If it hadn't been for me he would not have run across the road in a fright. Oh! I can see it now—the horse plunging, his hoofs over the child—and then the collapse, and the child hidden under the horse!"

They turned down a side street and then another, sinking into the squalour that still remains in that vague river district between Pimlico Pier and Milbank.

"Poor little chap! Punishment has come at last," said Kent. "It has a kind of way of doing so. What does Clytie think of it? Have you told her?"

"I only wrote to her yesterday. This morning I got a telegram. I think I have it with me. It is Clytie all over!"

She opened the purse she was carrying inside her muff and drew from it a crumpled telegram. It ran:

Dreadfully distressed. Get the best of everything, nurse, doctor. Find money to go on with in drawer at once. I must feel that I am doing something. Will write.

"Yes, it is like her," said Kent, with a smile, as he handed it back to her.

"I wonder whether you would mind doing something for me, Mr. Kent?" said Winnie after a pause. "Get the money out of Clytie's drawer for me. I have been so busy all day. Reggie is in bed with a bad cold and the house is upside down—and of course I have to come here. You see, I must use the money, or else Clytie would be hurt; it seems to me to be a matter of conscience."

"Or a matter of Clytie's telling you?" said Kent.

"Well, perhaps it's that. One always does what Clytie says. So do you, Mr. Kent. Anyhow, I should like to have the money for the sake of obeying her wishes. Could you get it for me?"

"Of course, if you will tell me how."

"Oh, that's easy. I have the key of her secretaire in my purse. She keeps her cash-box there. You can let me have it as it is. Will you?"

"Of course. I will bring it round to-night."

The early winter twilight had fallen and scared shivering indoors the brood of unwashed children that possess these gray, sordid streets. Here and there women stood at the doors, their hands folded in their aprons, with little ones clinging to their skirts, chaffering with a costermonger, or exchanging shrill confidences with a neighbour. Most of the front parlours on the ground floor were lightless, with drawn blinds. Here and there a public-house beer-can gleamed white upon the railing spikes. Workmen lurched heavily along, now and then followed by shawled, bare-armed wives, vituperative. For it was Saturday afternoon, when the businesslike wife looks after her husband. Here and there from a suddenly opened doorway came the smell of many weeks' cooking. The poorer classes despise fresh air in their rooms—perhaps because they get it for nothing.

Winifred stopped with Kent at a dark-fronted, dingy house, the facsimile of the forty other houses in the dingy row and of the forty

opposite across the narrow roadway. A little girl answered her knock.

"Mrs. Burmester in, my dear? Come, Mr. Kent, if you don't mind. I know the way."

Kent followed her up two flights of stairs, and into Mrs. Burmester's room. It was less squalid than he had imagined. A fire was burning in the grate, with a saucepan simmering. There were fairly substantial chairs, a table, and the ragged remains of a carpet. On a big bed by the side of the wall, not uncomfortable-looking nor unclean, lay Jack, tossing his wild elf head in delirium. By the side of the bed sat a nurse, whom the doctor had sent. Mrs. Burmester was spreading out the tea-things on the table. Her red, heavy face brightened momentarily when Winnie entered.

"How is he now?"

"Oh, mortal bad, miss. He hasn't had his senses all day."

"And the doctor—does he say anything?"

"He said he would like a consultation," replied the nurse, "but he did not know exactly whom to refer to."

"Why, to me, of course!" replied Winnie. "He knows my name and address. If you see him before I do, say I authorise him to do anything he thinks right. We are willing to—that is, he need not be hindered by questions of expense."

Winnie turned to Mrs. Burmester with the basket, which she had taken from Kent's hand. The mother thanked her, almost monosyllabically. She was too dull for emotions of any kind. Kent watched her with interest, for Clytie had often spoken of her, hinting at her own puzzle.

There was a lull in Jack's ravings as Winifred and Kent stood over the bed looking at him. The expression of sullen ferocity had gone from his face, which now seemed refined and gentle. He smiled at Winifred, not recognising her, murmured something incoherent about arithmetic. His mind had wandered back to his earlier school-days. He had been fond of a teacher there, his mother explained.

Her name was Miss Jones. She wished he was fond of anybody now. He was a sore trial to her. The floodgates of dull speech were opened and a slow stream of joyless anecdote poured forth—a jeremiad of Jack's iniquities. Winnie stopped her gently.

"We must not think of that now, Mrs. Burmester," she said. "We have to get him round again; and then we will see whether we can't make a good boy of him for you."

"Ah! You won't do that. He is too much like his father."

They stayed a little longer, talking. Then they went, as Winifred had to be back among her own family responsibilities.

"By the way," said Kent as they were walking homewards, "this must be Treherne's parish—in fact, I am sure of it. Has it not struck you?"

"No, it never occurred to me."

"Well, he ought to know. I'll send him a line. He knows all about this sort of thing."

He walked with her as far as the door of her own house. There she gave him the key of Clytie's secretaire. Mrs. Gurkins kept the room key. He left her and turned homewards, striding along rather fast, eager to execute Clytie's commission. He was filled with a foolish pleasure at her impulsive telegram; touched also at Winifred's implicit obedience and confidence.

"She's a queen among women!"

The silly phrase passed through his mind and he caught himself repeating it with his lips, half aloud.

"Bosh!" he added with some impatience. And he stopped to look in at a shop-window to divert his mind. It was a boot-shop. He ran his eye mechanically over the rows of commonplace, cheap boots, and then it fell upon a little pair of tan shoes, with broad silk laces. Before he realised how his mind was working, a picture rose before him of Clytie wearing a similar pair during the summer trip abroad.

He remembered bending down one day when a knot had slipped and retying it for her.

"I am becoming a positive ass!" he said to himself, with an angry jerk away from the window. Then he redoubled his pace, as if in defiance, but the silly phrase rang in his ears:

"She's a queen among women!"

He obtained the key from Mrs. Gurkins, and entered the tenantless room. The blinds were down, the curtains undrawn. It was just dark. He lit the piano candles and looked about him. How dreary the room seemed! The fireless grate, the coverless table (the cloth had been thriftily put away by Mrs. Gurkins), the absence of the feminine litter with which Clytie was wont to strew the room—all made his heart sink for a moment beneath the weight of a great longing. He remembered, too, the room by that dim light—on the evening of Clytie's submission. He saw her again lift her arms to unpin her hat from behind, the proud young figure standing out free as she looked at him half playfully, half seriously, her ripe, full lips parted in a smile. His breath came quickly as a flood of self-knowledge swept over him. He had felt puzzled then—at vague inarticulate desires. Now they were gathering a terribly real, objective shape. He grew dizzy, hot and cold, half terrified at himself.

With shaking fingers he fitted the key in the lock of the secretaire. In the drawer was a heterogeneous collection of odds and ends—letters, keys, ball-programmes, receipted bills—which he had to thrust aside so as to withdraw the little japanned cash-box. As he lifted it out a handkerchief came with it, caught by its lace edge, and after dangling a little fell at his feet. He picked it up, kept it in his hand, soothed at the softness. A faint odour of perfume rose from it, subtle and delicate—the well-known perfume that Clytie always used. It was like an emanation from herself. It grew over his highly strung senses like a breath of her own personality, sweet, intoxicating, overpowering. His brain swam. With a kind of groan he staggered to the sofa, threw himself upon it, burying his face in the little handkerchief, kissing it madly.

Now all was clear, waves of lightning flashing the truth through him. He loved her, passionately, desired her with a passion all the fiercer for its long restraint. Yet he could not think coherently. One thought, one utter realisation, overpowered all others. At last this great surging sex-tumult was sweeping through his veins.

"Oh, my God, I love her! Oh, my God, I love her!" That was all that he could groan out as he lay upon the sofa.

The creak of the door made him start up. On the threshold stood one of Mrs. Gurkins's curly-headed little children. She looked for a moment, rather frightened, at his haggard face, and then ran away. Thus aroused to a sense of external things, he locked up the secretaire and went out, taking the cash-box and handkerchief with him.

On the slab outside his rooms he found a letter in Clytie's familiar handwriting. He went into his room, and sitting down before his writing space, spread the letter out before him. It ran as follows:

My Dear Friend Kent:

If you ask me why I have not written to you for such a long time, I must shrink within my shell of femininity and refuse to give you reasons. For I have them, and they are compounded from a recipe handed down from Mother Eve. Well, I write to you now because I must. That reason I make you a present of.

I want to be in town again, in the King's Road, and to see you by the fireside, ready to be asked questions and to answer them, and to comfort your erratic friend Clytie with your kindness and wisdom. She is looked upon as a bad girl here, and pines for someone who thinks her human, and who also thinks her art human, and can help her in it.

Listen, now; I have got *the* subject at last; it is eating my heart out almost, I have to keep it hidden so to myself. I must tell you—for the sake's sake. "Faustina as a young, innocent girl, with the foreshadowings of passion on her face." There! Now you know. What do you think of it?

Do you remember my depression at Dinan? Well, I think it was there I got the conception. I can't tell you more. But it is haunting me. I feel what I want to do, but I can't get a face. What shall I do? Tell me. You know, dear Kent, in our talks, we have often disregarded principles that move the world pretty potently. But as an artist I am bound to recognise the part that passion plays in the tragedy of things.

"These things are life:

And life, some think, is worthy of the Muse,"

as Meredith says in "Modern Love." (Do you remember our reading it together?)

I can't write properly about it. I long for a talk with you. I shall break away soon and come for it. So be prepared with all your sympathy.

Do you miss me just a little bit? I often fancy my perverseness must give a little wholesome irritation to your life, and you are very good not to mind it. I always seem to be coming to you for help and sympathy. When can I ever do anything for you? You must tell me, dear friend, when the time comes.

I should like to tell you to give Winnie a kiss for me, but that is idiotic, isn't it? Yet you know what I mean. See that the dear child is not wearing herself out. There! I am asking you to do something else for me. Do write a long letter, full of yourself, with just a paragraph about the needs, artistic and otherwise, of

Your friend,

C. D.

Kent took some time to read this. The letters swam a little before his eyes. Then he laid his head upon his arms and thought, in dumb agony. Clytie's letter, sisterly and trustful, soothed and goaded him at once. "The part that passion plays in the tragedy of things!" God! Had a fleeting thought never struck her what a part it might play in their lives' tragedy? How could he answer that letter, addressed to a friend, received by a lover in the hot flush of newly awakened realisation? How could he meet her bright, frank look with this burning demon within him? It was base, horrible. His mind wandered to a German print he had seen somewhere, a goat-footed satyr kneeling and leering at Psyche. He shuddered.

It is given but to few men to know this terror of love: only to those who, like Kent, have hitherto expended vast animal and moral energies in non-sexual enthusiasms, and have rebelled with almost passionate repulsion against the assertion of the sexual principle. To some men love dawns like a sweet, fair star—the storm comes later on. To such as Kent it comes in terrific forked lightnings and crash of thunder, overwhelming the soul with terror. To Kent's excited fancy it seemed that the Beast, such as Wither had spoken of, had entered into him. He had betrayed the compact of friendship, her sisterly trust in him. Fool that he had been! Why had he not recognised it before? Now all was over between them. The future seemed nothing but black, rolling darkness.

The solitary gas-jet that he had lit on entering flared high and strident over the mantelpiece above the blackening fire, and Kent lay with his hands on his arms, his morbid brain at death-grapple with love, he himself heedful of nothing external—not even of a gay whistle and a quick, springing tread on the uncarpeted stairs. The door burst suddenly open.

"Come out, you fusty old hermit——"

Then Wither stopped. Kent raised a drawn, rather ghastly face and stared at him stupidly.

"My dear old chap, in the name of Heaven, what's the matter?" cried Wither, putting down his hat and stick and coming towards him.

"Oh, nothing!" said Kent, who pulled himself together with an effort, rose, and broke into a forced laugh.

Wither looked at him steadily while he slowly drew off his gloves.

"That's nonsense!" he said quietly.

Then his sharp glance fell on the little crumpled handkerchief that lay beside the open letter on the table. His quick sense, aided by certain opinions he had formed long since, grasped the main feature of the situation.

He went over to where Kent was standing by the fireplace, and laid his hand on his shoulder.

"Never mind, dear old man, it will all come right."

"It will never come right," groaned Kent absently.

"It must. She must care for you in time."

"How do you know what I am thinking of?" Kent burst out rather fiercely.

"I guessed. Besides—the handkerchief. It is not your own. Yours are a little more businesslike."

"Oh, well!" said Kent a little huskily, and throwing his head back with a gesture of impatience, "I can't hide it. What would be the good? I have found out that she is a friend no longer, that what you were saying the other night is true—and I feel a brute! My God, what a brute I feel!"

Wither's mental balance was for a moment upset. He righted it after a moment with considerations of his friend's character. In many fragile, nervous bodies there is a delicacy of perception which often remains all the keener when protected by a shell of cynicism.

"You want to be reasoned with gently, friend John," he said. "You must not feel a brute when you love a woman as a man like you can love. It's the best and holiest thing on God's earth, believe me."

"But, Teddy, she is so frank, so trustful, so proud of our friendship—it can never be the same again—if I should tell her, she would hate me——"

"You can bet your life she wouldn't!" murmured Wither.

"She would go out of my life in indignation, and she would be right," Kent went on. "She would scorn me for the feelings that I know now I have had all along for 'her. No; it is all over, all over. I can't meet her again. I think I shall go mad! I shall throw up everything and go away."

"You dear, foolish old chap," said Wither, "can't you see that very little would make her in love with you, if she is not so already? Why should you two not get married?"

"I marry!" gasped Kent, as if struck by a new idea. "I ask Clytie Davenant, with her beauty and intellect and genius, to come and share—this! Clytie Davenant marry me! Why, the idea is ludicrous—preposterous!"

"If I were she, I should not think so," said Wither affectionately.

Kent shook his head gloomily, and kicked the smouldering coal into a fitful blaze.

"No. Until she shows me unmistakably—which can be never—that she cares for me in that way, I would sooner bite my tongue out than tell her."

"Until she asks you to marry her, in fact! John Kent, you are two years older than I am, and three times as big. But verily you are a little child! And if you weren't," he added impulsively, with a soft glitter in his elfin eyes, "you would not be the lovable old chap that you are! Good-bye!"

"Oh, stay a little, Teddy!" cried Kent. "I'm not much company, but I——"

"Come round with me and have some dinner, then," interrupted Wither. "It will occupy your body—if not your mind. And it will be better for you than the bottled beer and sardines which you usually feast upon. I shall be quite alone and you can do some work for me."

"All right!" replied Kent dejectedly. "It does not matter what I do."

Wither turned his face to the fire, while Kent prepared to go out. When he turned round Kent was holding the cash-box in his hand. The handkerchief and letter were gone from the table, and Wither smiled inwardly. He had himself disposed of many such trifles in a similar way. Men are very much alike in several matters.

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